IN THE SPECIFICATION:

Please amend the specification as follows:

Please amend paragraph number **[0001]** as follows:

[0001] This application is a continuation of application Serial No. 08/609,354, filed March 1, 1996, ~~pending~~which is now United States Patent No. 6,825,596, issued November 30, 2004, which is a divisional of application Serial No. 08/089,166, filed July 7, 1993, which is now United States Patent No. 5,532,177, issued July 2, 1996. There is a ~~copending~~ continuation application having ~~serial number~~ Serial No. 08/555,908, which was filed on November 13, 1995, now abandoned. That copending application is a continuation of application Serial No. 08/089,166, which was filed on July 7, 1993 and issued as United States Patent ~~Number~~ No. 5,532,177 on July 2, 1996. Also, there is a divisional of application Serial No. 08/609,354, which was filed on September 25, 1998 as application Serial No. 09/161,338, now United States Patent No. 6,049,089 issued April 11, 2000.

Please amend paragraph number **[0006]** as follows:

[0006] Spindt, et. al. discuss field emission cathode structures in U.S. Patent Nos. ~~3,665,241,~~ 3,665,241; ~~3,755,704,~~ 3,755,704; ~~3,812,559,~~ 3,812,559; and 4,874,981. To produce the desired field emission, a potential source is provided with its positive terminal connected to the gate, or grid, and its negative terminal connected to the emitter electrode (cathode conductor substrate). The potential source may be made variable for the purpose of controlling the electron emission current. Upon application of a potential between the electrodes, an electric field is established between the emitter tips and the grid, thus causing electrons to be emitted from the cathode tips through the holes in the grid electrode.

Please amend paragraph number **[0011]** as follows:

[0011] One of the advantages of the present invention is the manufacturing ~~control,~~ control and available process window for fabricating emitters, particularly if a high-aspect ratio is desired. Another advantage of the present invention is its scalability to large areas.

Please add the following new paragraph **[0013A]**:

[0013A] Figure 1A is a schematic cross-section of a field emission device in which the emitter tips or edges formed from the process of an alternative of the present invention can be used;

Please amend paragraph number **[0014]** as follows:

[0014] Figure 2 (FIG. 2) is a schematic cross-section of the doped substrate of the present invention superjacent to which is a ~~mask;~~ mask, which in this embodiment ~~the mask~~ comprises several layers;

Please add the following new paragraphs **[0014A], [0015A], [0016A], and [0017A]**:

[0014A] Figure 2A is a schematic cross-section of another doped substrate of the present invention superjacent to which is a mask, which in this embodiment comprises several layers;

[0015A] Figure 3A is a schematic cross-section of the substrate of Figure 2A, after the substrate has been patterned and etched according to the process of the present invention;

[0016A] Figure 4A is a schematic cross-section of the substrate of Figure 3A, after the tips or edges have been formed according to the process of the present invention;

[0017A] Figure 5A is a schematic cross-section of the tips or edges of Figure 4A, after the nitride and oxide layers of the mask have been removed;

Please amend paragraph number **[0020]** as follows:

[0020] Figure 1 ~~FIG. 1~~ (FIG.1) is merely illustrative of the many applications for which the emitter 13 of the present invention can be used. The present invention is described herein with respect to field emitter displays, but one having ordinary skill in the art will realize that it is equally applicable to any other device or structure employing a micro-machined point, edge, or blade, such as, but not ~~limited, to~~ limited to, a stylus, probe tip, fastener, or fine needle.

Please amend paragraph number **[0021]** as follows:

[0021] The substrate 11 can be comprised of glass, for example, or any of a variety of other suitable materials, onto which a conductive or semiconductive material layer, such as doped ~~poly~~ polycrystalline silicon can be deposited. In the preferred embodiment, single crystal silicon serves as a substrate 11, from which the emitters 13 are directly formed. Other substrates may also be used including, but not limited ~~to~~ to, macrograin polysilicon and monocrystalline silicon, the selection of which may depend on cost and availability.

Please amend paragraph number **[0022]** as follows:

[0022] If an insulative film or substrate is used with the process of the present invention, in lieu of the conductive or semiconductive film or substrate 11, the micro-~~machined emitter~~cathode 13 should be coated with a conductive or semiconductive material prior to doping.

Please amend paragraph number **[0023]** as follows:

[0023] At a field emission site, a micro-cathode 13 (also referred to herein as an emitter) has been constructed in the substrate 11. The micro-cathode 13 is a protuberance that may have a variety of shapes, such as pyramidal, conical, wedge, or other geometry, which has a fine micro-point, edge, or blade for the emission of electrons. The micro-~~tip~~cathode 13 has an apex and a base. The aspect ratio (i.e., height-to-base width ratio) of the emitters 13 is preferably greater than 1:1. Hence, the preferred emitters 13 have a tall, narrow appearance.

Please amend paragraph number **[0024]** as follows:

[0024] The emitter 13 of the present invention has an impurity concentration gradient, indicated by the shaded area ~~13A),~~ 13A, in which the concentration is higher at the apex and decreases towards the base.

Please add the following new paragraph numbered **[0024A]**;

[0024A] The emitter 13 of an alternative of the present invention has an impurity concentration gradient, indicated by the shaded area 13A', in which the concentration is lower at the apex and increases towards the base.

Please amend paragraph number **[0025]** as follows:

[0025] Surrounding the micro-cathode 13 is an extraction grid or gate structure 15. When a voltage differential, through source 20, is applied between the micro-cathode 13 and the gate structure 15, an electron stream 17 is emitted toward a phosphor-coated screen 16. The phosphor-coated screen 16 functions as the anode. The electron stream 17 tends to be divergent, becoming wider at greater distances from the tip of micro-cathode 13.

Please amend paragraph number **[0026]** as follows:

[0026] The electron emitter 13 is integral with the semiconductor substrate 11 and serves as a cathode conductor. Gate structure 15 serves as ~~a~~ and extraction grid ~~structure~~ for its respective micro-cathode 13. A dielectric insulating layer 14 is deposited on the substrate 11. However, a conductive cathode layer (not shown) may also be disposed between the dielectric insulating layer 14 and the substrate 11, depending upon the material selected for the substrate 11. The dielectric insulating layer 14 also has an opening at the field emission site location.

Please amend paragraph number **[0027]** as follows:

[0027] The process of the present invention, by which the emitter 13 having the impurity concentration gradient is fabricated, is described below. ~~Accordingly, the figures relevant to this description could be characterized as illustrating an "in-process" device, which is a device that is in the process of being made.~~

Please amend paragraph number **[0028]** as follows:

[0028] Figure 2 (FIG. 2) shows the substrate or film 11 which is used to fabricate a field emitter 13. The substrate 11 is preferably single crystal silicon. An impurity ~~material~~ concentration gradient 13A is introduced into the substrate or film 11 in such a manner so as to create a concentration gradient from the top of the substrate 11 surface, which decreases with depth down into the film or substrate 11. Preferably, the impurity concentration gradient 13A is from the group including, but not limited to, boron, phosphorus, and arsenic.

Please add the following new paragraph **[0028A]**:

[0028A] Figure 2A (FIG. 2A) shows the substrate or film 11 which is used to fabricate a field emitter 13. The substrate 11 is preferably single crystal silicon. An impurity material 13A' is introduced into the film 11 in such a manner so as to create a concentration gradient from the top of the substrate surface 11 which increases with depth down into the film or substrate 11. Preferably, the impurity 13A' is from the group including, but not limited to boron, phosphorus, and arsenic.

Please amend paragraph number **[0029]** as follows:

[0029] The substrate 11 can be doped using a variety of available methods. The impurity ~~material~~ concentration gradient 13A can be obtained from a solid source diffusion disc or gas or vapor feed source, such as POC1, or from spin-on dopant with subsequent heat treatment or implantation or CVD film deposition with increasing dopant component in the feed stream, throughout the time of deposition, either intermittently or continuously.

Please amend paragraph number **[0030]** as follows:

[0030] In the case of a CVD or epitaxially grown film, it is possible to introduce an impurity that decreases throughout the deposition and serves as a component for retarding the consumptive process subsequently employed in the process of the present invention. An

example is the combination of a silicon film or substrate 11, doped with a boron impurity concentration gradient ~~13a,~~ 13A, and etched with an ethylene diamine pyrocatechol (EDP) etchant, where the EDP is employed after anisotropically etching pillars or fins from substrate 11.

Please amend paragraph number **[0031]** as follows:

[0031] In the preferred embodiment, the substrate 11 is single crystal silicon. After doping, the film or substrate 11 is then patterned, preferably with a resist/silicon nitride/silicon oxide sandwich etch mask 24 and dry etched. Other types of materials can be used to form the sandwich etch mask 24, as long as they provide the necessary selectivity to the substrate 11. The silicon nitride/silicon oxide sandwich has been selected due to its tendency to assist in controlling the lateral consumption of silicon during thermal oxidation, which is well known in semiconductor LOCOS processing.

Please amend paragraph number **[0032]** as follows:

[0032] The structure of Figure 2 (FIG. 2) is then etched, preferably using a reactive ion, crystallographic etch, or other etch method well known in the art. Preferably, the etch is substantially anisotropic, i.e., having undercutting that is reduced and controlled, thereby forming "pillars" ~~50 extending from a surface etched from~~ in the substrate 11, ~~. These~~ which "pillars" ~~50,~~ are ~~depicted in FIG. 3~~ depicted in Figure 3 (FIG.3) and will be the sites of the emitter tips 13 of the present invention.

Please add the following new paragraph **[0032A]**:

[0032A] The structure of Figure 2A (FIG 2A) is then etched, preferably using a reactive ion, crystallographic etch, or other etch method well known in the art. Preferably, the etch is substantially anisotropic, i.e., having undercutting that is reduced and controlled, thereby forming "pillars" in the substrate 11, which "pillars" are depicted in Figure 3A (FIG 3A) and will be the sites of the emitter tips 13 of the present invention.

Please amend paragraph number **[0033]** as follows:

[0033] Figure 4 (FIG. 4) illustrates the substrate 11 having emitter tips 13 formed therein. The resist portion 24A (FIG. 2) of the sandwich etch mask 24 has been removed. An oxidation is then performed, wherein an oxide layer 25 is disposed about the emitter tip 13 and subsequently removed.

Please add the following new paragraph **[0033A]**:

[0033A] Figure 4A (FIG. 4A) illustrates the substrate 11 having emitter tips 13 formed therein. The resist portion 24A (FIG. 2A) of the sandwich etch mask 24 has been removed. An oxidation is then performed, wherein an oxide layer 25 is disposed about the emitter tip 13 and subsequently removed.

Please amend paragraph number **[0034]** as follows:

[0034] Alternatively, an etch is performed, the rate of which is dependent upon (i.e., a function of) the concentration of the contaminants (impurities exposed to a consumptive process, whereby the rate or degree of consumption is a function of the impurity concentration, such as the thermal oxidation of silicon which has been doped with ~~phosphorus~~ impurity concentration gradient 13A).

Please amend paragraph number **[0035]** as follows:

[0035] The etch, or oxidation, proceeds at a faster rate in areas having higher concentration of impurities. Hence, the emitters 13 are etched faster at the apex, where there is an increased impurity concentration gradient ~~of impurities~~ 13A, and slower at the base, where there is a decrease in the impurity concentration gradient ~~of impurities~~ 13A.

Please amend paragraph number **[0036]** as follows:

[0036] The etch is preferably nondirectional in nature, removing material of a selected purity level in both horizontal and vertical directions, thereby creating an undercut. The amount of undercut is related to the impurity concentration gradient 13A.

Please amend paragraph number **[0037]** as follows:

[0037] Figure 5 (FIG.5) shows the emitters 13 following the removal of the nitride 24B and oxide 24C layers (shown in FIG. 2); preferably by a selective wet stripping process. An example of such a stripping process involves a 1:100 solution of hydrofluoric acid (HF)/water at 20° C, followed by a water rinse. Next is a boiling phosphoric acid (H_3PO_4)/water solution at 140° C, followed by a water rinse and a 1:4 hydrofluoric acid (HF)/water solution at 20° C. The emitters 13 of the present invention are thereby exposed. ~~It should be noted that, in the embodiment depicted in FIG. 5, the impurity concentration 13a at the base of the emitters 13 is generally zero.~~

Please add the following new paragraph **[0037A]**:

[0037A] Figure 5A (FIG. 5A) shows the emitters 13 following the removal of the nitride 24B and oxide 24C layers (shown in FIG. 2A); preferably by a selective wet stripping process. An example of such a stripping process involves a 1:100 solution of hydrofluoric acid (HF)/water at 20° C, followed by a water rinse. Next is a boiling phosphoric acid (H_3PO_4)/water solution at 140° C, followed by a water rinse and a 1:4 hydrofluoric acid (HF)/water solution at 20° C. The emitters 13 of the present invention are thereby exposed.